

**REMOVABLE CARTRIDGE FOR PCMCIA CARD AND ANCILLARY
STORAGE DRIVE**

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims the benefit of co-
pending U.S. provisional application Serial No.
60/277,364, filed March 20, 2001 by W. Glusing et al,
5 entitled: "Removable Cartridge for PC Card and Disk
Drive," assigned to the assignee of the present
application and the disclosure of which is incorporated
herein.

10 **FIELD OF THE INVENTION**

[0002] The present invention relates in general to a
ruggedized structure for housing, protecting and
interfacing an information device, such as, but not
limited to a PCMCIA (Personal Computer Memory Card
15 International Association) type card or similar circuit
card type of device, with electronic equipment, such as
but not limited to a portable personal computer (PC),
personal digital assistant (PDA), and the like. The
invention is particularly directed to a new and improved

information device-retaining cartridge, that is configured to protectively house one or more information devices for removable engagement with an internal electrical connector of host computer equipment, while
5 providing selective external access to either device.

BACKGROUND OF THE INVENTION

[0003] There are a number of information devices, such as PCMCIA (Personal Computer Memory Card International
10 Association) type cards, that are configured as relatively compact computer-interfaces, and are intended to serve as industry standard interconnections between an electronic unit, such as a personal computer, and an auxiliary device, such as a communication interface
15 (e.g. USB, Ethernet, wireless LAN/GPS antenna) modem, compact disk (CD) storage and retrieval unit, memory unit, and the like. Now although a compact information device may be configured to be readily 'plugged in' to a multipin socket of a device-receiving slot (e.g., card
20 slot) of host equipment, that capability alone does not ensure that the installation will be trouble free. This is especially true where the host unit is expected to be used in an environment subject to substantial 'hostile' ambient influences, such as vibration, as well as
25 moisture and foreign matter that may enter the host device through a device insertion slot.

[0004] Prior art proposals to deal with this problem have included the use of a protective sleeve designed to fit around a PCMCIA card, such as the sleeve device

described in U.S. Patent No. 5,575,670 (the '670 Patent), or a protective seal-retaining, 'end cap' type of adapter, such as that described in U.S. Patent No. 6,099,355 (the '355 Patent). Such an end cap adapter is
5 configured to engage one end of the card, providing a protective seal against the external surface of the computer surrounding the PCMCIA card slot, while also supplying an electrical link between an external connector, mounted on the adapter, and the input/output
10 receptacle of the PCMCIA card that has been inserted into engagement with an associated connector internally of the computer's PCMCIA card slot.

[0005] A shortcoming of the protective sleeve approach of the '670 Patent is the fact that it does not protect
15 the card's input/output port - something which the protective seal end adapter disclosed in the '355 Patent is designed to do. However, although the adapter of the '355 Patent is designed to provide a protective seal around the perimeter of the computer's card slot, it is
20 essentially an end cap with an electrical pass-through. As such, it cannot ensure that the card will properly mechanically and electrically engage a connector at the far end of the card slot. Instead, like other conventional card interfaces, proper engagement of the
25 (PCMCIA) card depends upon the relatively limited structure of the computer's card insertion slot, which is typically designed for a desk top or lap-top type of device.

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, these and other shortcomings of prior art device interfaces, such as those designed for PCMCIA type cards, are effectively obviated by a new and improved ruggedized 'cartridge'-based, information device-retention architecture. As will be described, the cartridge of the invention is sealable against the outer surface of a host (computer) unit, and is configured to removably hold or capture at least a first information device, such as a PCMCIA type card, memory drive, etc. The cartridge is configured to retain a device in a manner that provides for aligned engagement with an internal electrical connector within a cartridge-receiving slot of the host equipment.

[0007] In addition to retaining a first information device, the cartridge according to the invention is configured to protectively house a second information device, either individually, or simultaneously with the first device. The second device, such as an auxiliary memory drive, as a non-limiting example, is retained at a location of the cartridge that is separate from the location of the first device. Moreover, the cartridge may be configured to provide external access to either or both devices.

[0008] For this purpose, the cartridge of the invention comprises a generally rectangular cartridge frame that is slidably insertable along guide rails of a shrouded

cartridge-insertion slot of a host (computer) equipment, and securely retains at a first location thereof a first information device, such as an electronic PCMCIA card, or other type of device, such as an optical or a magnetic based component. When captured by the cartridge, the first device may readily engage a multipin electrical connector mounted on a host equipment's printed circuit board. One end of the cartridge frame has a faceplate that is sealable against the exterior surface of the housing of the host equipment.

[0009] A pair of generally longitudinally extending side rails extend parallel to and are slightly spaced apart from side edges of a top wall of the cartridge frame and support hold-down spring fingers of a hold-down spring element. Those portions of the surface of the top wall between the side edges of the top wall and the side rails support the cartridge on a pair of guide rails of a cartridge insertion slot.

[00010] The hold-down spring fingers have generally flat, stripe shaped portions supported by the longitudinally extending side rails when the hold-down spring element is affixed to the frame. The hold-down spring fingers have respective device (e.g., PCMCIA type card)-engaging, V-shaped distal ends, that are adapted to engage and be spring-biased against the top surface of a device that has been placed upon the top wall of the cartridge frame, thereby mechanically urging the captured device into a generally 'snug' flat abutment

with the cartridge frame.

[00011] A generally flat and relatively thin device (e.g., card) retention plate has a pair of spaced apart, generally flexible device-retention tangs that extend
5 generally transverse to the plane of the plate and are sized to engage a rearward edge of a device retained on the cartridge frame. By abutting the end of the device/card, the retention tangs prevent its translation along the longitudinal (device insertion/removal)
10 direction of the cartridge. This serves to ensure that a multiconductor socket at the forward end of the captured device will fully mechanically and electrically mate with a multipin carrier connector atop a carrier connector printed circuit board mounted at the forward
15 end of the frame and containing wiring to an external multipin cylindrical cable connector.

[00012] Like its forward end, the rearward end of the captured device that is engaged by the retention tangs contains a multiconductor socket that is configured to
20 mate with a multipin connector mounted to a printed circuit board within the host equipment. The multipin connector is adjoined by a 'capture' plate, that is configured to engage the retention plate when the cartridge is fully inserted into the host unit. The
25 capture plate is configured to maintain the retention tangs against the device, until the device's multiconductor socket has become fully disengaged from its associated multipin connector on the printed circuit board within the host unit, in the course of removal of

the cartridge. This ensures that the device will not remain engaged with the multipin connector on the printed circuit board due to socket-pin friction during removal of the cartridge from the host unit.

- 5 **[00013]** A light pipe element is affixed to the forward portion of the top wall adjacent to the carrier connector and serves to optically couple an optical indicator on the device to an associated aperture in the cartridge faceplate. External electrical access to the carrier connector for the captured device is provided by
10 way of a multipin cylindrical cable connector mounted at a first location of the faceplate. Also, external electrical access to a multipin electrical connector for a second device, such as an auxiliary card, may be
15 provided by way of a multipin cylindrical cable connector mounted at a second location of the faceplate.

- [00014]** A generally V-shaped connector-restriction cam is pivotally mounted on the cartridge faceplate between the two multipin cylindrical connectors. When pivoted
20 against either one of the connectors, the V-shaped cam allows cable connection access to the other connector, but mechanically prevents access to the one connector. The cam prevents electrical cables from simultaneously engaging both connectors. It also has a bore that
25 provides optical access to the light pipe element.

[00015] The bottom wall of the cartridge frame retains a printed circuit board having a device-capture frame in which a second device, such as an auxiliary (microdrive) memory element, is removably insertable. A flexible tab

may be attached to the second device to facilitate its removal from its associated printed circuit board. Configuring the cartridge to retain a second device, such as, but not limited to an ancillary memory card, facilitates transport of multiple devices in a common protective enclosure and may be critical in a hostile/restricted access environment. This can be especially useful, where the second device comprises an auxiliary card that is used to supply ancillary data to an application program with which the host equipment is used.

[00016] The cartridge insertion slot of the host device is configured to receive and engage the device-retention cartridge. To protect adjacent components of the host equipment's printed circuit boards, and also provide a guide for the cartridge, a protective shroud of electrically insulating material is mounted to the host equipment's internal printed circuit board structure adjacent to the cartridge insertion slot. The sidewalls of the shroud have interior stand-off guide rails that serve to maintain a device that has been mounted at the top wall of the cartridge frame in spaced apart relationship from various components of the computer's circuit board, as the cartridge travels along the rails during its insertion into or removal from the host unit. Similarly, the top of the shroud prevents the device support structure on the bottom wall of the cartridge frame from coming in contact with components of the host unit.

[00017] A multipin connector on the host equipment's circuit board has a generally linear array of electrical conductor pins that are engageable by an associated linear array of socket conductors of a device that has been captured on the cartridge frame. A capture plate is mounted atop the multipin connector so as to extend slightly beyond distal ends of the pins. This ensures that the capture plate will engage the retention plate just prior to the array of socket conductors of the device coming into contact with the array of electrical conductor pins of the connector, as the cartridge is inserted into the insertion slot of the host unit.

[00018] This anti tang-deflection force of the capture plate against the retention plate maintains the retention tangs against the device, so that friction between the multipin connector and the multipin socket of card cannot cause the installed information device (such as a PCMCIA type card) to produce a deflection of the tangs, that might otherwise allow the device to become detached from the cartridge during the latter's removal from the host equipment. Once the device's multiconductor socket has become fully disengaged from the multipin connector, the anti-deflection force of the capture plate against the tangs is no longer required, and the tangs will remain engaged with the information device as the cartridge is removed.

BRIEF DESCRIPTION OF THE DRAWINGS

[00019] Figures 1 and 2 are respective partially exploded top and bottom perspective views of an information
5 device-retention cartridge in accordance with the present invention;

[00020] Figure 3 is a perspective view of the cartridge of Figures 1 and 2, showing the faceplate in exploded detail;

10 [00021] Figures 4 and 5 are partially exploded opposite side perspective views of a host equipment's housing structure having a cartridge insertion slot configured to receive the cartridge of Figures 1-3;

[00022] Figure 6 is a diagrammatic end view of a host
15 unit's casing having a cartridge insertion slot for receiving the cartridge of Figures 1-3;

[00023] Figures 7 and 8 are respective end and perspective views of a protective guide shroud for the cartridge of Figures 1-3; and

20 [00024] Figures 9 and 10 are diagrammatic partial side views illustrating the retention tang bias functionality of the capture plate of the cartridge of Figures 1-3.

DETAILED DESCRIPTION

25 [00025] Attention is initially directed to Figures 1 and 2, which are respective partially exploded top and bottom perspective views of an information device-retention cartridge in accordance with the invention. The cartridge comprises a generally rectangularly-

configured frame 10, having a pair of spaced apart generally rectangular, parallel side walls 11 and 12, that adjoin and are solid with a top wall having adjoining, offset topwall portions 13 and 19, and a
5 bottom wall or floor 14. As will be described, the cartridge frame is configured to be readily slidably inserted along guide rails of a shrouded cartridge-insertion slot of a host (computer) equipment or unit, so as to securely seat a device, such as but not limited
10 to a PCMCIA type card that is retained by the cartridge, in aligned engagement with an electrical connector installed at an interior region of the cartridge insertion slot. In this cartridge-installed position, a sealing member in the form of a gasket is sized to
15 surround the cartridge insertion slot on the interior side of a cartridge faceplate becomes sealed against the host, and thereby protect its interior from the entry of moisture and foreign matter.

[00026] For this purpose, a forward end 15 of the frame
20 10 is affixed to an interior face 21 of a faceplate 20 shown in detail in the exploded perspective view of Figure 3. In order to prevent undesired rotation or play of the frame 10 relative to the faceplate 20, left and right side portions of the forward edge 15 of the frame
25 10 may be keyed to be inserted into corresponding indents or slots in the interior face 21 of the faceplate. The faceplate is sized to engage the exterior surface of the housing of a host equipment (e.g., portable computer). As a non-limiting example, Figures 4

and 5, to be described, show the host unit as having a generally rectangularly shaped housing and retaining a computer circuit board with a multipin connector for electrically engaging pins of an associated connector of a device retained by the cartridge.

[00027] As further shown in Figures 1 and 3, adjacent to respective spaced apart side walls 11 and 12 of the cartridge frame 10, top wall portion 19 has a pair of generally longitudinally extending side rails 31 and 32, spaced part from the forward end 15 and a rearward end 16 of the frame 10. These side rails extend parallel to and are slightly spaced apart from side edges of the top wall portion 19, so as to leave respective surface portions 17 and 18 of the top wall portion 19 of the cartridge frame 10 that are used to support the cartridge on a pair of guide rails of a cartridge insertion slot, as will be described.

[00028] Side rails 31 and 32 are configured to receive and support respective hold-down spring fingers 41 and 42 of a hold-down spring element 40. The hold-down spring element 40 further includes a device connector shroud 43, that is solid with respective forward ends 44 and 45 of the hold-down spring fingers 41 and 42. The forward ends 44 and 45 of the hold-down spring fingers 41 and 42 have respective slots 46 and 47 for receiving fittings, such as screws and the like (shown at 36 and 37), for attachment to associated (threaded) bores 48 and 49 in the top wall portion 19 adjacent to the forward end of the cartridge frame 10. Similarly,

respective rearward ends 51 and 52 of the hold-down spring fingers 41 and 42 have respective slots 46 and 47 for receiving fittings (shown at 38 and 39), for attachment at associated bores 53 and 54 adjacent to the rearward end 16 of top wall portion 13 of the cartridge frame 10.

[00029] The respective hold-down spring fingers 41 and 42 have generally flat, stripe-shaped portions 61 and 62, that are sized to rest upon and be supported by associated flat top surfaces 33 and 34 of the longitudinally extending side rails 31 and 32, when the hold-down spring element 40 is affixed to the cartridge frame 10. Extending alongside these stripe-shaped portions 61 and 62, the hold-down spring fingers 41 and 42 have respective device (e.g., PCMCIA type card)-engaging portions 63 and 64 with generally V-shaped distal ends 65 and 66. As such, the distal ends of the hold-down spring fingers 41/42 are adapted to engage and be spring-biased against the top surface of an information device (such as a PCMCIA type card), that has been placed upon the top wall of the cartridge frame 10, so as to mechanically urge the device into a generally 'snug' flat abutment with the top wall of cartridge frame 10.

[00030] A generally flat, relatively thin, device-retention plate 70 has bores 71 and 72 that are sized to receive the fittings 38 and 39 for attaching rearward ends 51 and 52 of the hold-down spring fingers 41 and 42 to the rearward end 16 of top wall portion 13 of the

cartridge frame 10. This retention plate 70 has a pair of spaced apart, generally flexible flanges 75 and 76, distal ends of which have respective device-retention tangs 73 and 74, that extend upwardly or generally transverse to the plane of the plate 10, and are sized to engage a rearward edge of a device retained on the top wall of the cartridge frame 10. By abutting the end of the installed information device, the card-retention tangs 73 and 74 prevent translation of the captured device/card along the longitudinal (card insertion/removal) direction of the cartridge.

[00031] As noted briefly above, this ensures that a multiconductor socket at the forward end of the captured device/card will be fully mechanically and electrically mated with a multipin carrier connector 80 atop a carrier connector printed circuit board 82, that has been mounted to respective, reduced land portions 83 and 84 of side rails 31 and 32 adjacent to the forward end of cartridge frame 10. To provide external electrical connectivity with the captured device, a multipin (cylindrical) cable connector may be mounted on the faceplate 20. The printed circuit board 82 may contain wiring to external multipin cylindrical cable connector 100, to facilitate changing either connector, as required.

[00032] Like its forward end, the rearward end of the device/card engaged by the card-retention tangs 73 and 74 has a multiconductor socket, configured to mate with a multipin connector that mounted to a printed circuit

board within the host device. As will be described, this multipin connector is adjoined by a 'capture' plate, that is configured to engage retention plate 70, when the cartridge is fully inserted into the host equipment.

- 5 **[00033]** In particular, the capture plate is configured to maintain the retention tangs 73 and 74 against the captured information device/card, until the latter's multiconductor socket has become fully disengaged from its associated multipin connector on the printed circuit
10 board within the host unit, in the course of removing the cartridge. This ensures that the cartridge-retained device/card cannot be 'left behind' (still engaged with the multipin connector on the printed circuit board due to socket-pin friction) during removal of the cartridge
15 from the host unit.

- [00034]** A light pipe element 90 having a mounting portion 91 is affixed to the forward portion 15 of the top wall portion 19, adjacent to the carrier connector 80, by means of a suitable fastener (e.g., screw) 92, and
20 serves to optically couple an optical indicator of the information device/card to an associated aperture 94 in the faceplate 20. As noted above, external electrical access to the carrier connector 80 for the device/card may be provided by way of multipin cylindrical cable
25 connector 100, shown as having a grounding ring 129 at a first aperture 101 of the faceplate 20. In like manner, where external electrical access to a multipin electrical connector for a second information device, such as an auxiliary card shown at 220 in the frame

bottom view of Figure 2, is to be provided, a multipin cylindrical cable connector 120 (having an associated grounding ring 109) may be mounted at a second aperture of the faceplate 20.

- 5 **[00035]** Where it is desired to provide external electrical access to each of first and second information devices retained by the cartridge, the multipin (cylindrical) connectors 100 and 120 may be positioned on the faceplate 20 with a generally V-shaped
- 10 connector-restriction cam 130 pivotally mounted therebetween. The restriction cam may be pivotally mounted to the faceplate by way of a screw 131 threaded into a bore 133 in faceplate 20. In this configuration, when the V-shaped cam 130 is pivoted against either one
- 15 of the connectors, cable connection access to the other connector is allowed, but denied to the one connector. In this manner, the cam 130 prevents electrical cables from simultaneously engaging both connectors 100 and 120. In addition to being pivotable between the two
- 20 connectors, and being sized and shaped to allow only one of the two connectors 100 and 120 at the time to be engaged by an associated cable, cam 130 has a bore 132 that provides optical access to the light pipe element 90.
- 25 **[00036]** The faceplate 20 also contains respective fasteners 103 and 105, such as thumbscrews or the like, that are configured to engage bores in the host unit's housing, on either side of the cartridge insertion slot, so that the cartridge may be securely retained in the

host unit. A generally rectangular shaped gasket 140 of a suitable moisture-proof material, such as neoprene rubber containing a conductive material, is installed on the interior face 21 of the faceplate 20, and is sized to surround the cartridge insertion slot. This effectively provides two functions. First, the cartridge faceplate 20 becomes moisture-sealed against the host unit's housing; second, the sealing gasket is sized to allow the interior face 21 of faceplate 20 to sit flush with and electrically contact the mating surface of the housing structure 310 and 320 around the cartridge insertion slot 330, shown in Figure 6. This serves to minimize radiation of electromagnetic interference (EMI) through the cartridge insertion slot.

15 [00037] As further shown in the bottom perspective view of Figure 2, the bottom wall 14 of the frame 10 may support a second information device. For this purpose, the bottom wall has a plurality of bores (four of which are shown at 201, 202, 203 and 204), that are sized to receive associated fasteners 211, 212, 213 and 214, such as screws and the like, for retaining a printed circuit board (PCB) 220. PCB 220 has a device-capture frame 230 with respect to which a second information device, such as an auxiliary memory drive 200, is removably insertable. Similar to the printed circuit board 82 that supports the carrier connector 80 for the first device/card, described above, printed circuit board 220 may contain wiring to an associated external multipin cylindrical cable connector 120, mounted on the

faceplate 20, as described above. To facilitate removal of the second device 200 from its capture frame 230 mounted to the bottom wall of the cartridge, a flexible tab 232 may be adhesively attached to the device. Also, 5 a connector may be provided to allow the second device to be interfaced with an associated connector of the host unit.

[00038] As pointed out above, the cartridge of the present invention is capable of retaining one or more 10 devices at respective support locations that are separate and distinct from one another. In the non-limiting example, shown herein, the first device (e.g., a PCMCIA type card) is configured to become engaged with the host device, when the cartridge is installed in its 15 cartridge insertion slot, whereas the second device, such as an auxiliary microdrive, is retained in a non (host)-engaged configuration at a separate support location (at the bottom) of the frame. This manner of retaining the second (auxiliary) device takes advantage 20 of the space availability provided by the cartridge. As noted earlier, this can be especially useful where the second device may comprise an auxiliary memory device, that is used to supply ancillary data to an application program with which the host equipment is used. The 25 availability of auxiliary storage space and electrical access facilitates transport of both cards in a common protective enclosure and may be critical in a hostile/restricted access environment.

[00039] Figures 4 and 5 are partially exploded opposite

side perspective views of a non-limiting example of the housing structure of a host unit (e.g., portable personal computer) having a cartridge insertion slot that is configured to receive and engage a device-
5 retention cartridge in accordance with the invention described above with reference to Figures 1-3. As shown in Figures 4 and 5, the components of the host unit proper may be distributed on one or more electronic printed circuit boards 300, in a stacked or spaced apart
10 arrangement secured to generally longitudinally configured 'right' and 'left' half casings 310 and 320, joined together to form a protective enclosure for the host unit (computer). The half casings are also shown as including generally semi-cylindrical portions 311 and
15 321 that form a cylindrical battery compartment, in a manner customary in the art.

[00040] As shown in the casing end view of Figure 6, respective 'forward' end walls 312 and 322 of the half casings are configured to form respective halves 313,
20 323 of a cartridge insertion slot 330, that is sized to receive the cartridge described above. In order to protect adjacent components of the host unit's printed circuit boards and guide the cartridge as it is being inserted into the slot 330, a protective shroud 340 of
25 electrically insulating material, shown in the diagrammatic end view of Figure 7 and in the perspective view of Figure 8, is mounted to printed circuit board structure 300 immediately adjacent to card insertion slot 330.

[00041] To guide the cartridge into aligned engagement with a multipin connector 350 and an associated capture plate 360 mounted on the printed circuit board structure 300, respective sidewalls 341 and 342 of the shroud 340 are provided with interior stand-off guide rails 343 and 344 affixed to the printed circuit board structure 300. These non-conductive guide rails serve to maintain a device, such as PCMCIA type card mounted at the top wall of the cartridge frame 10, spaced apart from various components 301 of the PCB 300, as the cartridge travels along the rails during its insertion into or removal from the host device. The sidewalls 341 and 342 of the shroud terminate at a top or cover 345, that provides structural integrity to the protective shroud 340 and insure constant and exact aligned engagement of a multiconductor socket at the forward end of the device with the multipin carrier connector 80 atop the carrier connector printed circuit board 82.

[00042] As shown in the perspective view of Figure 5 and the diagrammatic partial side view of Figure 9, the multipin connector 350 is mounted to the PCB 300 and contains a generally linear array of electrical conductor pins 351. The connector 350 is configured such that its pins 351 may be readily engaged by an associated linear array of socket conductors 371 of a device 370 retained on the top wall of the cartridge frame 10, as described above. As shown in Figure 9, the capture plate 360 is mounted atop the multipin connector 350 so as to extend slightly beyond distal ends over the

pins 351.

[00043] As a result, as shown in Figure 10, in the course of the cartridge being inserted into the insertion slot 320 of the host unit and traveling along the guide rails 343 and 344, the capture plate 360 will engage the retention plate 70 just prior to the array of socket conductors 371 of the device 370 coming into contact with distal ends 352 of the array of electrical conductor pins 351 of the connector 350. This anti tang-
5 deflection force of the capture plate 360 against the retention plate 70 will maintain the tangs 73 and 74 against the device/card 370, so that friction between the multipin connector 350 and the multipin socket of card 370 cannot cause the device/card to produce a
10 deflection of the tangs, that might otherwise allow the device to 'escape' or become detached from the cartridge during the latter's removal from the host unit. Once the device's multiconductor socket 371 has become fully disengaged from the multipin connector 350, the anti-
15 deflection force of the capture plate 360 against the tangs 73 and 74 is no longer required, and the retention tangs will remain engaged with the device as the cartridge is removed from its insertion slot.
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[00044] As will be appreciated from the foregoing
25 description, shortcomings of prior art information device interfaces are effectively obviated by the ruggedized 'cartridge'-based device/card retention architecture of the invention. This cartridge not only protects and holds a device, such as a PCMCIA type card,

for aligned engagement with an internal electrical connector of a cartridge-receiving slot of a host computer unit, but can also house an auxiliary device, such as a microdrive, separate from the first device, while providing external access to either or both devices. Each device can be independently accessed and/or removed, for example, to comply with security requirements for a given function.

[00045] While we have shown and described several embodiments in accordance with the present invention, it is to be understood that the same is not limited thereto but is susceptible to numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are obvious to one of ordinary skill in the art.